STATUTORY DECLARATION

I, Kazumi TAKANO, of Taiyo Seimei Otsuka Building 3F, 2-25-1, Kitaotsuka, Toshimaku, Tokyo, 170-0004, Japan, do solemnly and sincerely declare as follows:

I am well acquainted with the English and Japanese languages.

The attached translation is true into the English language of the accompanying certified copy of the document filed in the name of Fuji Photo Film Co., Ltd., in the Japanese Patent Office on 28 October 2002, in respect to an application for Patent.

This 17th day of November 2005,

Kazumi Takano

Kazumi TAKANO

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office

Date of Application: 28 October 2002

Application Number: Pat. Appl. 2002-312052

Applicant(s): Fuji Photo Film Co., Ltd.

29 August 2003

Commissioner,

Japan Patent Office Yasuo IMAI

Certification Number 2003-3070688

[TITLE OF THE DOCUMENT] Patent Application

[REFERENCE NUMBER] P20021028D

[FILING DATE] 28 October 2002

[ATTENTION TO] Commissioner of the Patent Office

[INTERNATIONAL PATENT CLASSIFICATION] B41J 2/365

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[FEE]

[PREPAYMENT BOOK NUMBER] 011844

[PAID AMOUNT] 21,000

[LIST OF FILED DOCUMENTS]

[TITLE] Specification 1

[TITLE] Drawings 1

[TITLE] Abstract 1

[NECESSITY OF PROOF] Need

[TITLE OF DOCUMENT] Specification

[TITLE OF THE INVENTION] Thermal printer, temperature correcting method for thermal head, and thermosensitive recording material

[Scope Of Claims]

[CLAIM 1] A thermal printer for pressing a thermal head against a themosensitive recording material and applying heat thereto to record an image by coloring, said thermal printer characterized by comprising a controller for measuring temperature of said thermosensitive recording material by a temperature sensor to control heat energy from said thermal head based on measured temperature.

[CLAIM 2] A thermal printer as defined in claim 1, characterized in that said thermosensitive recording material is provided with said temperature sensor and a receiver for receiving temperature data wirelessly transmitted from said temperature sensor.

[CLAIM 3] A temperature correcting method for a thermal head for pressing said thermal head against a themosensitive recording material and applying heat thereto to record an image by coloring, said temperature correcting method characterized by comprising the steps of:

measuring temperature of said thermosensitive recording material by a temperature sensor; and

controlling heat energy from said thermal head based on measured temperature.

[CLAIM 4] A thermosensitive recording material for use in a thermal printer provided with a thermal head, characterized by comprising a temperature sensor for wirelessly transmitting temperature data of said themosensitive recording material to said thermal printer.

[Detailed Description of the Invention]

[0001]

[TECHNICAL FIELD]

The present invention relates to a thermal printer for correcting temperature of a thermal head, a temperature correcting method for a thermal head, and a thermosensitive recording material.

[0002]

[BACKGROUND ART]

There is known a thermal printer for pressing a thermal head against a thermosensitive recording material and applying heat thereto to record an image by coloring. For example, a color thermal printer uses a color thermosensitive recording material including a cyan thermosensitive coloring layer, a magenta thermosensitive coloring layer, and a yellow thermosensitive coloring layer sequentially laminated on a support. In order to develop each color of the thermosensitive coloring layers of the color thermosenstive recording material selectively, heat energy for coloring (mJ/mm^2) of each of the thermosensitive coloring layers is different from each other. The lower the thermosensitive coloring layer is, the greater heat energy for coloring is. Additionally, when a second thermosensitive

coloring layer is subjected to thermal recording, so as not to develop again the color of a first thermosensitive coloring layer above the second thermosensitive coloring layer, the uppermost and intermediate thermosensitive coloring layers have an optical fixation property, respectively. Further, the greater the heat energy applied to the thermosensitive coloring layer is, the greater the coloring density is.

[0003]

The thermal head includes a plurality of heating elements linearly arranged to record an image for one color line by line. When an image for one line is recorded, driving time per one drive and the number of drive pulses of each heating element are adjusted according to its gradation level. Further, heat energy from the thermal head is controlled to develop the color of the predetermined thermosensitive coloring layer at a desired density.

[0004]

Heat energy applied by the thermal head to the color thermosensitive recording material changes when head temperature of the thermal head changes. This causes changes in the density of a recorded image. There is known a constitution for preventing such changes in the density due to changes in the temperature, in which the head temperature of the thermal head is measured and an interval of printing of the thermal head is controlled according to the head temperature to correct heat energy applied by the thermal head to the color thermosensitive recording material (see Reference 1, for example).

[0005]

[Reference 1] Japanese Patent Laid-open Publication Number 7-61020

[0006]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

However, as described above, although the heat energy is corrected based on the head temperature of the thermal head, this correction is not based on the temperature of the color thermosensitive recording material itself. Therefore, it is not possible to correct the heat energy adequately.

[0007]

In view of the foregoing problems, an object of the present invention is to provide a thermal printer for adequately correcting heat energy to be applied to a color thermosensitive recording material, a temperature controlling method for a thermal head, and a thermosensitive recording material.

[0008]

[MEANS FOR SOLVING THE PROBLEMS]

To achieve the above object, according to the present invention, there is provided a thermal printer for pressing a thermal head against a themosensitive recording material and applying heat thereto to record an image by coloring. The thermal printer is characterized by including a controller for measuring temperature of the thermosensitive recording material by a temperature sensor to control heat energy from the thermal head based on measured temperature.

[0009]

A thermal printer as defined in claim 1 is characterized in that the thermosensitive recording material is provided with the temperature sensor and a receiver for receiving temperature data wirelessly transmitted from the temperature sensor.

[0010]

According to the present invention, there is provided a temperature correcting method for a thermal head for pressing the thermal head against a themosensitive recording material and applying heat thereto to record an image by coloring. The temperature correcting method is characterized by including the steps of: measuring temperature of the thermosensitive recording material by a temperature sensor; and controlling heat energy from the thermal head based on measured temperature.

[0011]

According to the present invention, there is provided a thermosensitive recording material for use in a thermal printer provided with a thermal head. The thermosensitive recording material is characterized by including a temperature sensor for wirelessly transmitting temperature data of the themosensitive recording material to the thermal printer.

[0012]

[BEST EMBODIMENTS OF THE INVENTION]

FIG. 1 is a schematic view illustrating constitution of a color thermal printer 10 of the present invention. A recording material roll 21 is loaded in the color thermal printer 10. The recording material roll 21 is constituted by a color thermosensitive recording material 20 with a long length wound

around a feeding section (not shown) in a roll form. The color thermosensitive recording material 20 is unwound from the recording material roll 21 to a feeding path. The fed color thermosensitive recording material 20 is moved back and forth between the forward and backward directions, thus printing is performed.

[0013]

As shown in FIG. 2, the color thermosensitive recording material 20, as is well known, is composed of three coloring layers including cyan, magenta, and yellow thermosensitive coloring layers 22, 23, and 24, and a transparent protective layer 25, sequentially laminated on a recording surface of a support 26. Among the thermosensitive coloring layers, the yellow thermosensitive coloring layer 24 as an uppermost layer has the highest sensitivity to heat, and develops a yellow color in response to heat energy of the lowest level. The cyan thermosensitive coloring layer 22 as a lowermost layer has the lowest sensitivity to heat, and develops a cyan color in response to heat energy of the highest level. The magenta thermosensitive coloring layer 23 has an optical fixation property under ultraviolet rays of 365nm, and the yellow thermosensitive coloring layer 24 has an optical fixation property under ultraviolet rays of 420 nm (near ultraviolet rays). The color thermosensitive recording material 20 may be composed of four coloring layers including a black coloring layer, for example.

[0014]

A recording material temperature sensor 30 is incorporated in the support 26 for measuring temperature of the color thermosensitive recording material 20. A color thermal printer 10 includes a system controller 13. The recording material temperature sensor 30 wirelessly transmits data of temperature of the color thermosensitive recording material 20 (hereinafter referred to as recording material temperature) to the system controller 13. As shown in FIG. 3, the recording material temperature sensor 30 is contained in a front end-side blank margin 20b outside a recording area 20a. The blank margin 20b is cut away by a cutter (not shown) after the printing operation to the recording area 20a is completed.

[0015]

A feed roller set 11 is caused to rotate in both forward and backward directions by a pulse motor 12, and nips the color thermosensitive recording material 20 fed to the feeding path therebetween to move the same back and forth. A system controller 13 controls the rotation of the pulse motor 12.

[0016]

A thermal head 14 is disposed upstream from the feed roller set 11 in the forward direction. The thermal head 14 includes a heating element array 14b composed of a plurality of heating elements 14a arranged linearly, keeps the heating element array 14b in contact with the recording surface of the color thremosensitive recording material 20, and applies heat thereto, to record an image by coloring. A platen roller 15 is disposed so that the feeding path for the color thermosensitive recording

material 20 lies between the platen roller 15 and the heating element array 14b, and supports the color thermosensitive recording material 20. An image is thermally recorded on the color thermosensitive recording material 20 in a state where the color thermosensitive recording material 20 is nipped between the thermal head 14 and the platen roller 15.

[0017]

A head temperature sensor 14c is incorporated in the thermal head 14 for measuring the temperature of the thermal head 14 itself (hereinafter referred to as head temperature). When the head temperature or the recording material temperature changes, heat energy generated by the thermal head 14 changes. Thus, a voltage applied to the thermal head 14 is adjusted by correction according to the head temperature obtained by the head temperature sensor 14c and the recording material temperature obtained by the recording material temperature sensor 30. This is effective in correcting the heat energy of the thermal head 14 according to changes in the temperature, and preventing changes in the density due to the changes in the temperature.

[0018]

A front end detective sensor 16 is disposed upstream from the thermal head 14 in the forward direction. The front end detective sensor 16 detects a front end of the color thermosensitive recording material 20 in the forward direction, and provides the system controller 13 with a detection signal. In response to the detection signal from the front end detective

sensor 16, the system controller 13 starts counting drive pulses to be sent to the pulse motor 12, and controls a positioned state and moving amount of the color thermosensitive recording material 20 until the end of the printing operation.

[0019]

A photo fixer 17 is disposed downstream form the feed roller set 11. The photo fixer 17 includes a reflector 17a, a yellow fixing lamp 17b, and a magenta fixing lamp 17c. The yellow fixing lamp 17b emits the yellow fixing light. The magenta fixing lamp 17c emits the magenta fixing light. A system controller 13 is controlled to turn on the fixing lamps 17b and 17c respectively for optical fixation of the recorded yellow and magenta thermosensitive coloring layers.

[0020]

A cutter (not shown) is disposed downstream from the photo fixer 17. The cutter cuts away the blank margin 20b and the printed portion of the color thermosensitive recording material 20.

[0021]

FIG. 4 is a block diagram illustrating electrical constitution of the color thermal printer 10 and the recording material temperature sensor 30. The system controller 13 generally controls respective sections included in the color thermal printer 10. The various elements are connected with the system controller 13, including the front end detective sensor 16, the head temperature sensor 14c, a head driver 18, an antenna 19, a frame memory 41, and a head voltage correction section

42.

[0022]

The image data is read from the frame memory 41, and written to a line memory 43 line by line for each of the colors by the system controller 13. Thereafter the image data is transmitted to the head driver 18.

[0023]

The head voltage correction section 42 corrects the head voltage according to the head temperature obtained by the head temperature sensor 14c and the recording material temperature obtained by the recording material temperature sensor 30. Data of a level of the corrected voltage is transmitted to the head driver 18.

[0024]

The head driver 18 drives the thermal head 14 according to the image data and the corrected voltage. The head driver 18 applies the head voltage to the thermal head 14 at a level depending on the corrected voltage. A set of drive pulses associated with pixel density is produced according to the image data, and sent to the thermal head 14 to which the head voltage is applied. The adjustment of the head voltage can equally adjust the heat energy generated by each of the heating elements 14a. Note that, instead of adjusting the head voltage, other parameters may be adjusted, such as driving time per one drive pulse, a time interval of printing, and the like.

[0025]

The first antenna 19 is connected with the system

controller 13, and receives the recording material temperature data from the recording material temperature sensor 30. Electromagnetic waves are transmitted and received between the first antenna 19 and the recording material temperature sensor 30, so the first antenna 19 can receive the recording material temperature data. The recording material temperature sensor 30 includes a sensor section 31 and a second antenna 32. The sensor section 31 measures the recording material temperature. The second antenna 32 transmits the measured recording material temperature data to the first antenna 19. For this purpose, a communication system between the antennas 19 and 32 is a type according to the non-contact IC memory such as wireless tags. The first antenna 19 sends a signal of powering to the recording material temperature sensor 30 with electromagnetic waves as carrier, so that the powering of the recording material temperature sensor 30 is started by use of a power source.

[0026]

Immediately before the start of printing with the thermal head 14, the system controller 13 causes the first antenna 19 to supply the recording material temperature sensor 30 with power, and start operation of the recording material temperature sensor 30. Thus, the system controller 13 receives the recording material temperature data. Then the system controller 13 sends the received recording material temperature data to the head voltage correction section 42 together with the head temperature data.

[0027]

The operation of the above constitution is described by referring to the flowchart in FIG. 5. A command signal is input at first. The color thermosensitive recording material 20 is fed to the feeding path in response to the command signal. The fed color thermosensitive recording material 20 is nipped by the feed roller set 11 and moved in the forward direction. When the front end of the color thermosensitive recording material 20 reaches the front end detective sensor 16, the system controller 13 starts counting drive pulses sent to the pulse motor 12.

[0028]

When the front end of the recording area 20a of the color thermosensitive recording material 20 reaches the heating element array 14b, recording of the yellow image is started. For the yellow image recording, the head voltage for the thermal head 14 is corrected. The system controller 13 receives the recording material temperature from the recording material temperature sensor 30 by way of the first antenna 19. The system controller 13 sends the head voltage correction section 42 the recording material temperature and the head temperature measured by the head temperature sensor 14c.

[0029]

According to the two values of the temperature, the head voltage correction section 42 determines the corrected voltage, and sends the same to the head driver 18. The head driver 18 receives the corrected voltage and the image data read from the line memory 43, and drives the thermal head 14.

[0030]

After the yellow image is thermally recorded, the thermally recorded portion of the color thermosensitive recording material 20 is moved to the photo fixer 17 serially, and subjected to the yellow optical fixation. After the yellow image is thermally recorded and subjected to the optical fixation, the unwound portion of the color thermosensitive recording material 20 is once wound back. The color thermosensitive recording material 20 is fed in the forward direction again. When the front end of the recording area 20a comes again to the thermal head 14, the magenta image starts being recorded. For the magenta image recording, the head voltage is corrected according to the recording material temperature and the head temperature as in the case of the yellow image recording.

[0031]

The magenta image recording is effected according to the above process as in the case of the yellow image recording. After the magenta image is recorded, the head voltage is corrected according to the recording material temperature and the head temperature similarly before the cyan image is recorded. After the printing, the blank margin 20b and the printed portion of the color thermosensitive recording material 20 are cut away and ejected.

[0032]

Note that, although the blank margin including the recording material temperature sensor is cut away after the

printing operation in the above embodiment, the blank margin may not be cut away.

[0033]

In the above embodiment, the temperature sensor 30 incorporated in the color thermosensitive recording material 20 is used for wirelessly measuring the recording material temperature. However, the recording material temperature sensor 30 may be combined with an element different from the recording material. For example, a thermal printer can be provided with the temperature sensor, which can contact the color thermosensitive recording material and measure the recording material temperature. According to the recording material temperature obtained by the temperature sensor, the head voltage may be corrected. However, in this case, a problem may occur in that scratches or damages occur on a surface of the thermosensitive recording material because of the contact of the temperature sensor on the thermosensitive recording material. Accordingly, the above-described feature of the embodiment is still preferable in that the recording material temperature sensor is incorporated in the thermosensitive recording material, measures the thermosensitive recording material temperature, and transmits the recording material temperature to the thermal printer wirelessly.

[0034]

In the above embodiment, the recording material temperature is measured before an image starts being recorded with the thermal head. An image of one frame is recorded at the

head voltage corrected according to the recording material temperature at the time. However, the recording material temperature may be measured for two or more times in the recording of one frame image, and the head voltage may be corrected each time of measuring the recording material temperature. In this case, as shown in FIG. 6, a color thermosensitive recording material 50 is provided with a plurality of recording material temperature sensors 60a to 60e arranged in an edge portion along one lateral edge of the color thermosensitive recording material 50. While the color thermosensitive recording material 50 is moved, temperature of respective sections of the color thermosensitive recording material 50 can be measured by the color thermosensitive recording material temperature sensors 60a to 60e.

[0035]

In the above embodiment, the heat energy is corrected according to the parameters including the recording material temperature and the head temperature. However, other parameters may be additionally considered, such as a temperature around the thermal head.

[0036]

[EFFECT OF THE INVENTION]

As described above, according to the present invention, the temperature sensor included in the thermosensitive recording material is used to measure the temperature of the thermosensitive recording material, thereby correcting heat energy of the thermal head according to the recording material

temperature. Accordingly, it is possible to correct the heat energy adequately.

[0037]

Further, according to the present invention, the temperature of the thermosensitive recording material is obtained wirelessly for preventing contact between the temperature sensor and the thermosensitive recording material. Accordingly, scratches or damages are not occurred on the surface of the thermosensitive recording material.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Figure 1] An explanatory view illustrating constitution of a color thermal printer of the present invention.

[Figure 2] A cross sectional view of a color thermosensitive recording material illustrating an arrangement of a recording material temperature sensor.

[Figure 3] An explanatory view of the color thermosensitive recording material illustrating the arrangement of the color thermosensitive recording material temperature sensor.

[Figure 4] A block diagram illustrating electrical constitution of the color thermal printer in combination with the thermosensitive recording material temperature sensor.

[Figure 5] A flowchart illustrating a process of correcting a head voltage.

[Figure 6] An explanatory view of the color thermosensitive recording material illustrating another arrangement of recording material temperature sensors.

[DESCRIPTION OF THE REFERENCE NUMBERS]

10 color thermosensitive recording material

13 system controller

14 thermal head

18 head driver

19 first antenna

20 color thermal printer

30 recording material temperature sensor

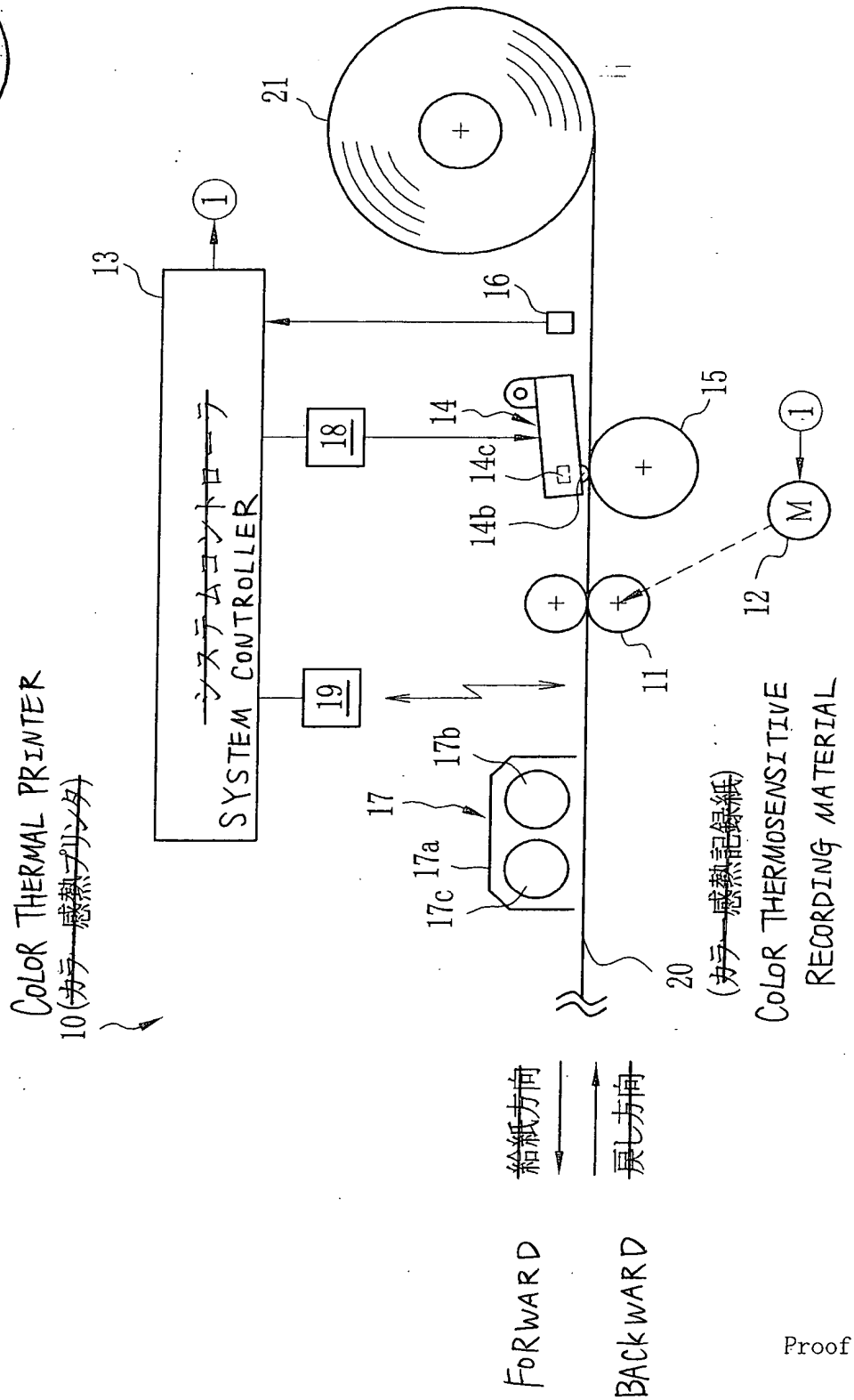
31 sensor section

32 second antenna

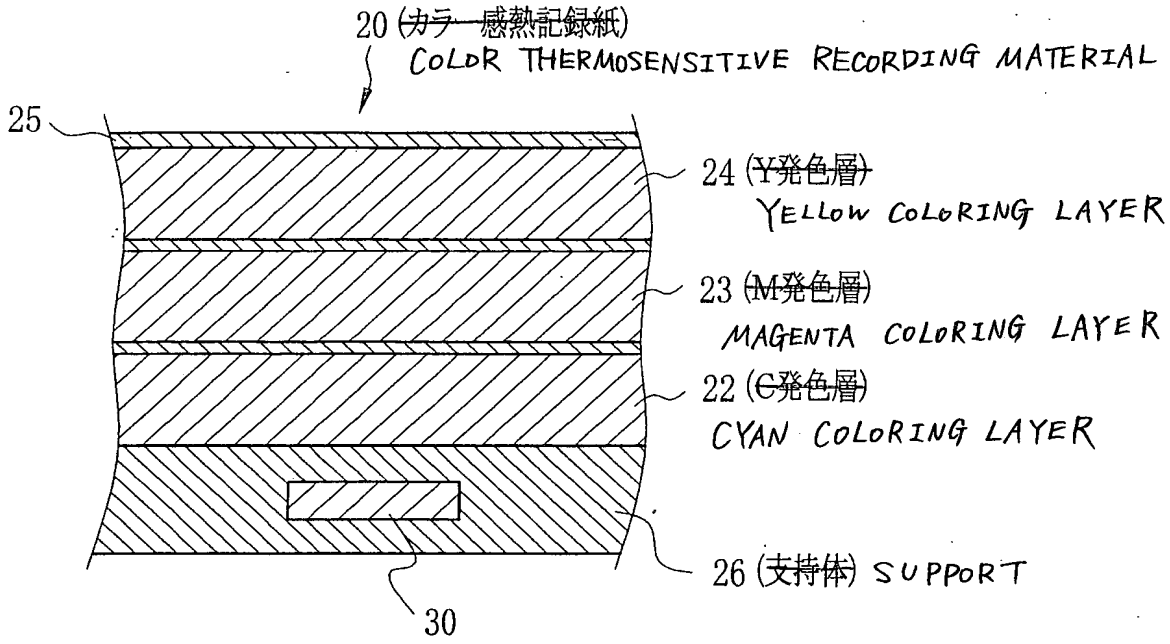
42 head voltage correction section

【書類名】　図面　[DOCUMENT NAME] DRAWING

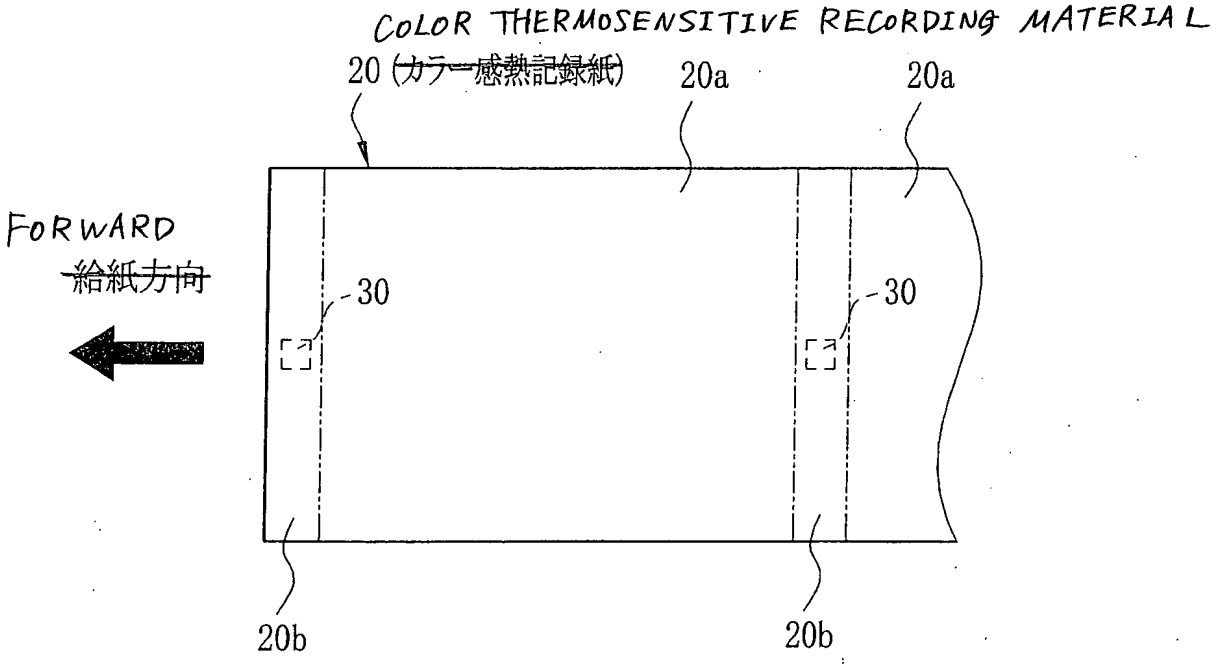
【図１】　[FIGURE 1]



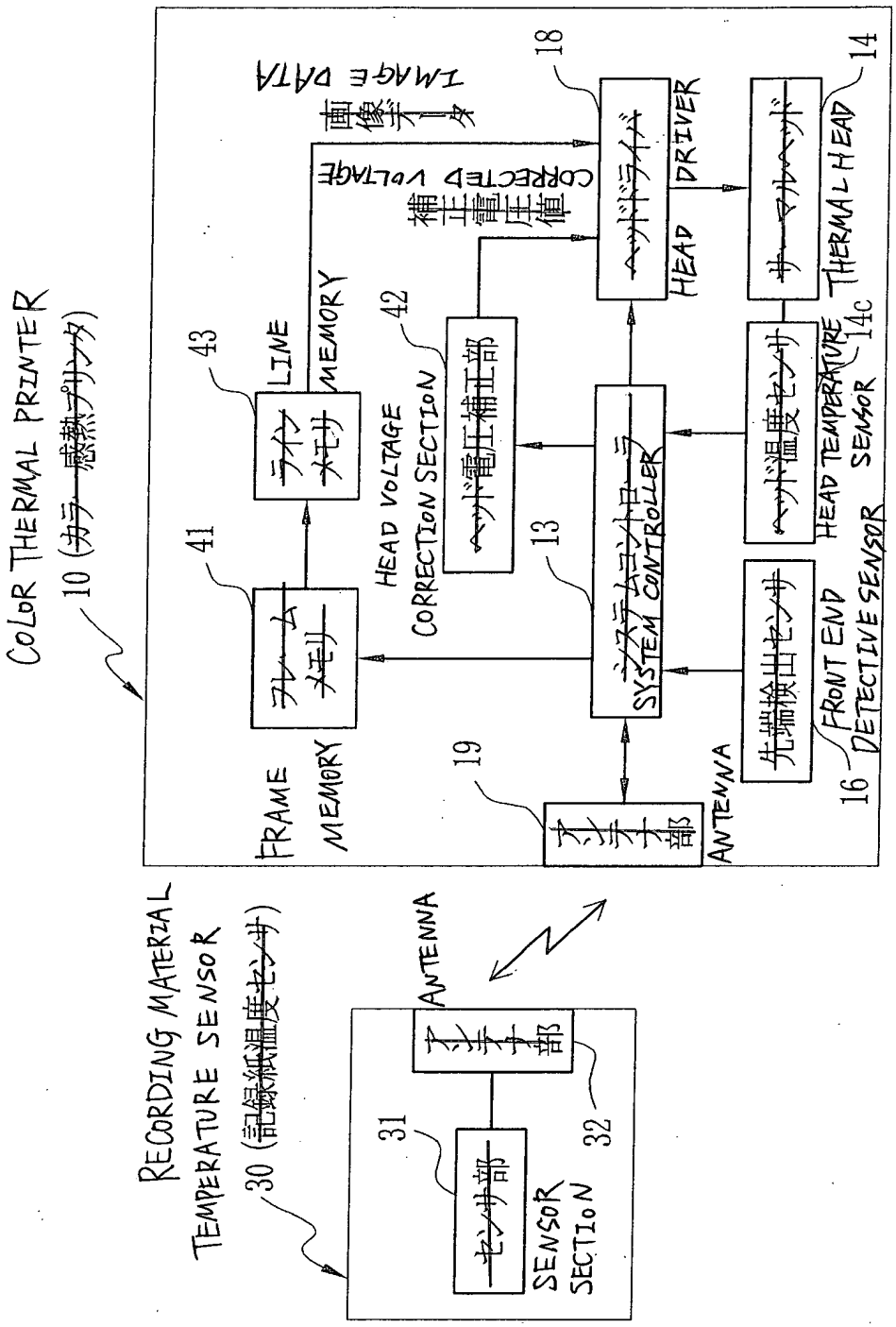
~~[図２]~~ [FIGURE 2]



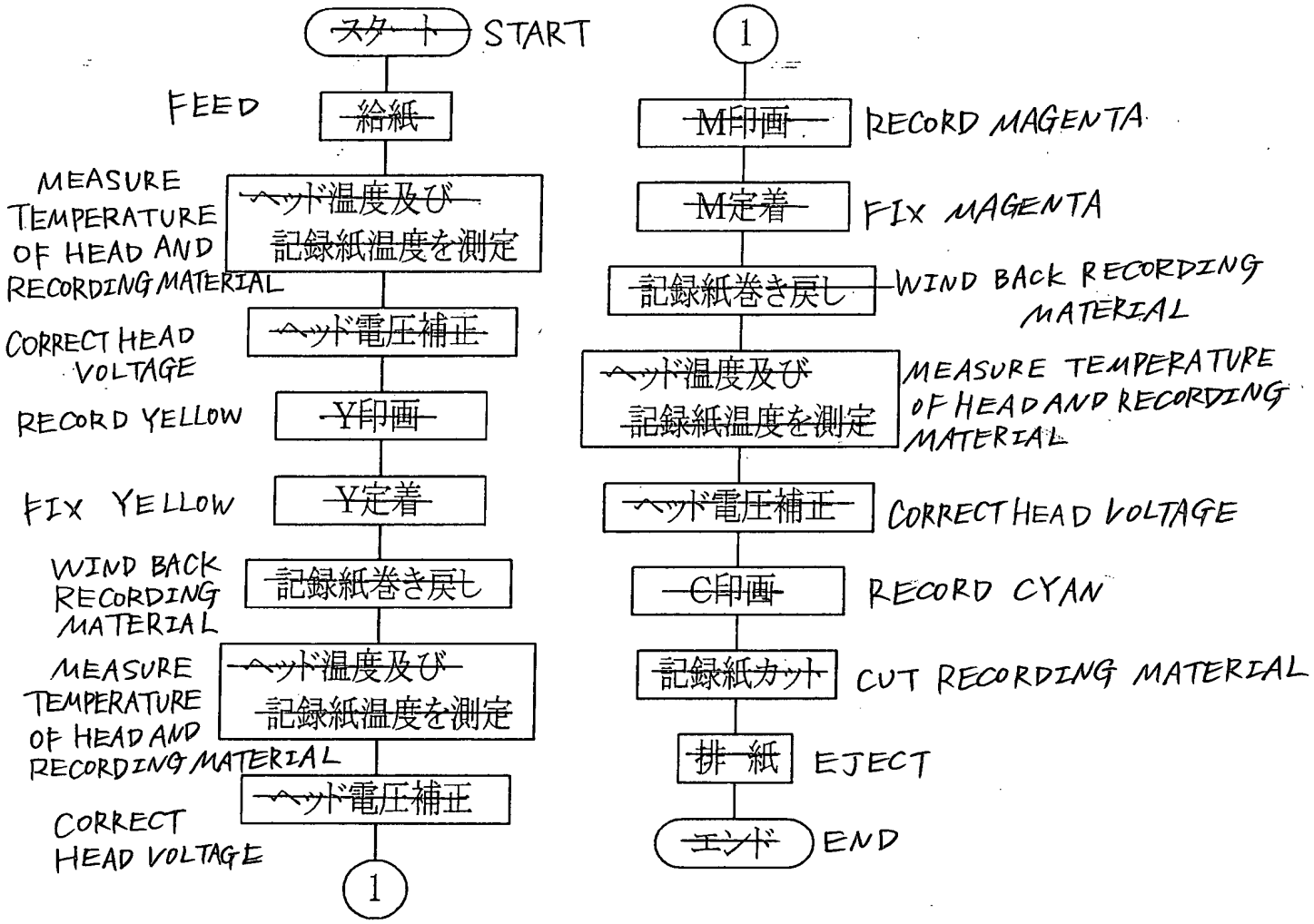
~~[図３]~~ [FIGURE 3]



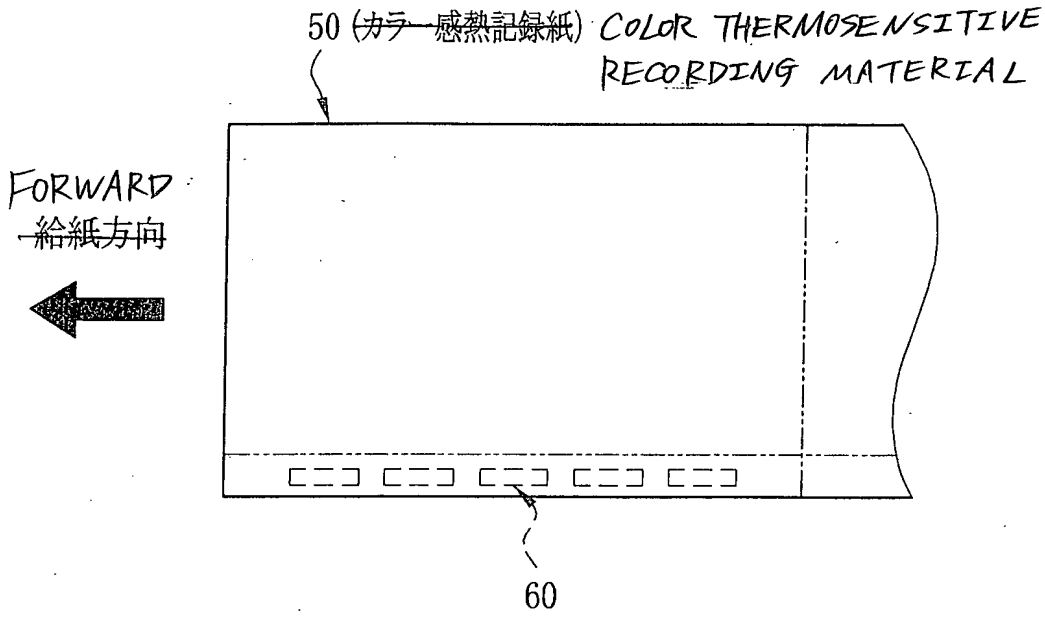
~~【図４】~~ [FIGURE 4]


COLOR THERMAL PRINTER
10 (カラー感熱プリンタ)
IMAGE DATA
画像データ
18
CORRECTED VOLTAGE
補正電圧値
HEAD DRIVER
ヘッドドライバ
THERMAL HEAD
サーマルヘッド
14
43
LINE MEMORY
ラインメモリ
42
HEAD VOLTAGE CORRECTION SECTION
ヘッド電圧補正部
HEAD
14c
HEAD TEMPERATURE SENSOR
ヘッド温度センサ
41
FRAME MEMORY
フレームメモリ
13
SYSTEM CONTROLLER
システムコントローラ
19
ANTENNA
アンテナ部
FRONT END DETECTIVE SENSOR
先端検出センサ
16
RECORDING MATERIAL TEMPERATURE SENSOR
30 (記録紙温度センサ)
ANTENNA
アンテナ部
31
SENSOR SECTION
センサ部
32

~~[図5]~~ [FIGURE 5]


~~スタート~~ START
FEED
~~給紙~~
MEASURE TEMPERATURE OF HEAD AND RECORDING MATERIAL
~~ヘッド温度及び記録紙温度を測定~~
CORRECT HEAD VOLTAGE
~~ヘッド電圧補正~~
RECORD YELLOW
~~Y印画~~
FIX YELLOW
~~Y定着~~
WIND BACK RECORDING MATERIAL
~~記録紙巻き戻し~~
MEASURE TEMPERATURE OF HEAD AND RECORDING MATERIAL
~~ヘッド温度及び記録紙温度を測定~~
CORRECT HEAD VOLTAGE
~~ヘッド電圧補正~~
1
1
~~M印画~~
RECORD MAGENTA
~~M定着~~
FIX MAGENTA
~~記録紙巻き戻し~~
WIND BACK RECORDING MATERIAL
~~ヘッド温度及び記録紙温度を測定~~
MEASURE TEMPERATURE OF HEAD AND RECORDING MATERIAL
~~ヘッド電圧補正~~
CORRECT HEAD VOLTAGE
~~C印画~~
RECORD CYAN
~~記録紙カット~~
CUT RECORDING MATERIAL
~~排紙~~
EJECT
~~エンド~~
END

~~【図６】~~ [FIGURE 6]


50 (~~カラー感熱記録紙~~) COLOR THERMOSENSITIVE RECORDING MATERIAL
FORWARD
~~給紙方向~~
60

[TITLE OF DOCUMENT] Abstract

[ABSTRACT]

[OBJECT] Adequately correcting heat energy to be applied to a thermosensitive recording material, by correcting a head voltage to be applied to a thermal head.

[RESOLUTION] A recording material temperature sensor 30, which is incorporated in the thermosensitive recording material, measures the temperature of the thermosensitive recording material (recording material temperature). A system controller 13 obtains recording material temperature data by transmitting/receiving electromagnetic waves to/from the recording material temperature sensor 30, immediately before the start of printing of respective colors. The obtained recording material temperature data is transmitted to a head voltage correction section 42 together with head temperature data which is obtained by a head temperature sensor 14c. The head voltage correction section 42 corrects the head voltage according to these temperatures. The corrected voltage value is sent to a head driver 18. The head driver 18 applies the head voltage, according to the corrected voltage value, to the thermal head 14.

[ELECTED FIGURE] Figure 4